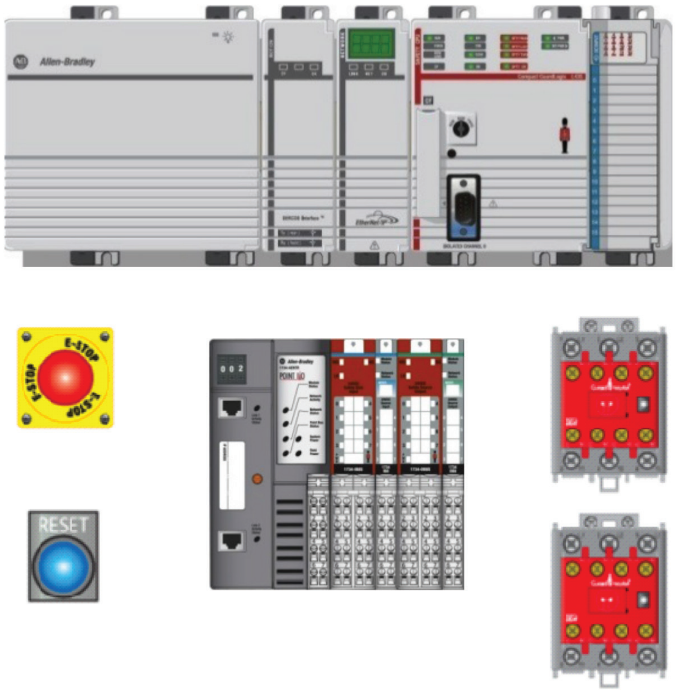

Safety Function: Emergency Stop
Products: GuardLogix® Series Connection of E-stops

Safety Rating: PLd, Cat. 3 to EN ISO 13849.1 2008

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Table of Contents

Introduction

This Safety Function application note explains how to wire, configure, and program a Compact GuardLogix® controller and POINT Guard I/O™ module to monitor a series of dual-channel safety E-stop devices. If any of the E-stops is actuated or a fault is detected in the monitoring circuit, the GuardLogix controller de-energizes the final control device, in this case, a redundant pair of 100S contactors.

This example uses a Compact GuardLogix controller, but is applicable to any GuardLogix controller.

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication **SGI-1.1** available from your local Rockwell Automation® sales office or online at **http://www.rockwellautomation.com/literature**) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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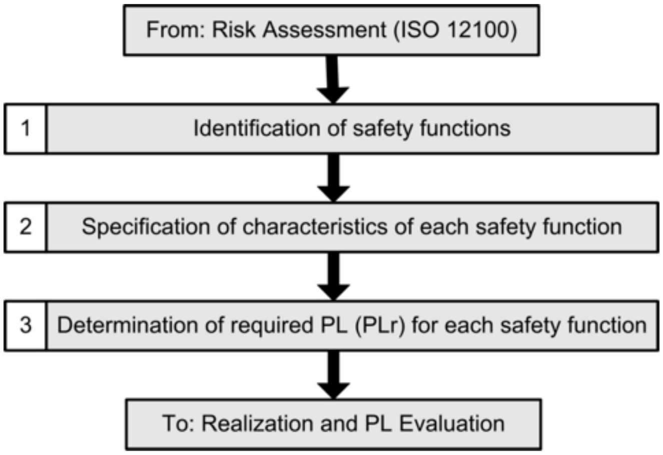
Safety Function Realization: Risk Assessment

The required performance level is the result of a risk assessment and refers to the amount of the risk reduction to be carried out by the safety-related parts of the control system. Part of the risk reduction process is to determine the safety functions of the machine. For the purposes of this document the assumed required performance level is Category 3, PLd.


From: Risk Assessment (ISO 12100)
1
Identification of safety functions
2
Specification of characteristics of each safety function
3
Determination of required PL (PLr) for each safety function
To: Realization and PL Evaluation

Emergency Stop Safety Function

Emergency stop by actuation of an emergency stop push button.

Safety Function Requirements

Pressing of any one of the series wired E-Stops will stop and prevent hazardous motion by removal of power to the motor. Upon resetting the E-Stop pushbutton, hazardous motion and power to the motor will not resume until a secondary action (start button depressed) occurs. Faults at the E-Stop button, wiring terminals or safety controller will be detected before the next safety demand. This Emergency Stop function is complementary to any other safeguards on the machine and shall not reduce the performance of other safety related functions.
The safety function in this example is capable of connecting and interrupting power to motors rated up to 9A, 600VAC.

The safety function will meet the requirements for Category 3, Performance Level "d" (Cat 3, PLd), per ISO 13849-1, and SIL3 per IEC 62061, and control reliable operation per ANSI B11.19.

Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

⚠	**WARNING:** Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.
⚠	**ATTENTION:** Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.
⚡	**SHOCK HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
♨	**BURN HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

General Safety Information

Contact Rockwell Automation to find out more about our safety risk assessment services.

IMPORTANT	This application example is for advanced users and assumes that you are trained and experienced in safety system requirements.
⚠	**ATTENTION:** A risk assessment should be performed to make sure all task and hazard combinations have been identified and addressed. The risk assessment may require additional circuitry to reduce the risk to a tolerable level. Safety circuits must take into consideration safety distance calculations which are not part of the scope of this document.

Functional Safety Description

Hazardous motion is interrupted or prevented by actuation of any emergency stop pushbutton (ES1, ES2 or ES3). Each E-Stop is considered a separate safety function. The E-stop pushbuttons are connected in series to a pair of safety inputs of a Safety Input module (SI1). The safety contactors (K1 & K2) are connected to a pair of safety outputs of a Safety Output module (SO1). The I/O modules are connected via CIP Safety over an EtherNet/IP network to the Safety Controller (SC1). The safety code in SC1 monitors the status of the E-Stop pushbuttons using a pre-certified safety instruction named Dual Channel Input Stop (DCS). When all conditions are satisfied, no faults are detected on the input modules, and the reset push button is pressed, a second certified function block called Configurable Redundant Output (CROUT) checks the status of the final control devices, a pair of 100S redundant contactors. The controller then issues an output signal to the safety output module (SO1) to switch ON a pair of outputs to energize the safety contactors.

Bill of Material

This application example uses these components.

Catalog Number	Description	Quantity
800FM-MT34MX02	800F Non-illuminated Mushroom Operators, Twist To Release, 30 mm, Round Metal, Red, Metal Latch Mount, 2 N.C. Contact(S)	3
800FM-G611MX10	800F Reset Push Button - Metal, Guarded, Blue, R, Metal Latch Mount, 1 N.O. Contact(S), Standard	1
100S-C09ZJ23C	Bulletin 100S-C - Safety Contactors	2
1768-ENBT	CompactLogix™ EtherNet/IP Bridge Module	1
1768-L43S	Compact GuardLogix Processor, 2.0 MB standard memory, 0.5 MB safety memory	1
1768-PA3	Power Supply, 120/240 VAC Input, 3.5 A @ 24V DC	1
1769-ECR	Right End Cap/Terminator	1
1734-AENT	24V DC Ethernet Adapter	1
1734-TB	Module Base with Removable IEC Screw Terminals	4
1734-IB8S	POINT Guard Safety Input Module	1
1734-OB8S	POINT Guard Safety Output Module	1
1783-US05T	Stratix 2000™ Unmanaged Ethernet Switch	1

Setup and Wiring

For detailed information on installing and wiring, refer to the product manuals listed in the **Additional Resources**.

System Overview

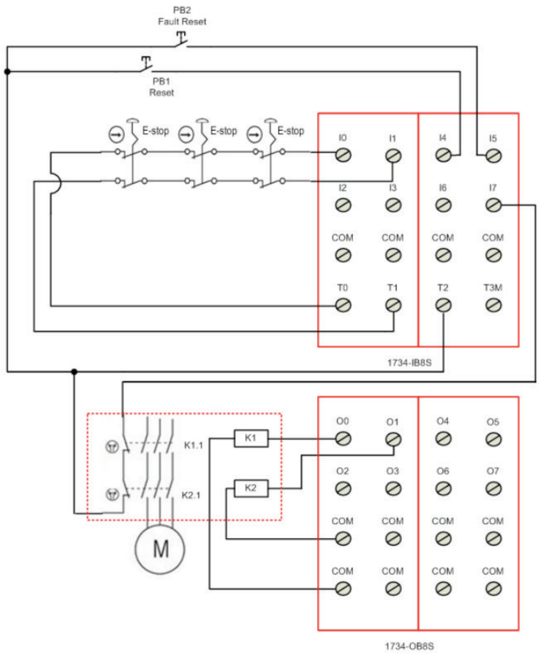
The 1734-IB8S input module monitors the inputs from the E-stops, which are connected in series. This method conserves the number of inputs that are used, but reduces the granularity of system diagnostics. Typically E-stops are not operated as often as a safety gate, for example; therefore the need to connect each E-stop contact into its own dedicated input is reduced.

An E-stop is considered to be a complementary safety device.

EN 12100-2 5.5.1 provides details on complementary protective measures. These are measures which are neither inherently safe design nor safeguarding, but are required due to intended use or reasonably foreseeable misuse of the machine. The circuit is tested by using test pulses (T0 and T1) on the inputs, I0 and I1. These test pulses source the 24V DC for the circuit. By periodically dropping the 24V DC to OV DC, it is possible to detect cross-channel faults and shorts to an external 24V DC. Shorts to 0V DC will be seen as an open circuit by the input and will be detected by either the hardware, if configured to detect discrepancy errors, or by the appropriate safety function block in the application code.

The final control device in this case is a pair of 100S safety contactors, K1 and K2. The contactors are controlled by a 1734-OBS safety output module. These are wired in a redundant configuration and are tested on start up for faults. The start-up test is accomplished by using a CROUT instruction to monitor the feedback circuit into input 7 (I7) before the contactors are energized. The system is reset by means of the momentary push button, PB1.

Electrical Schematic



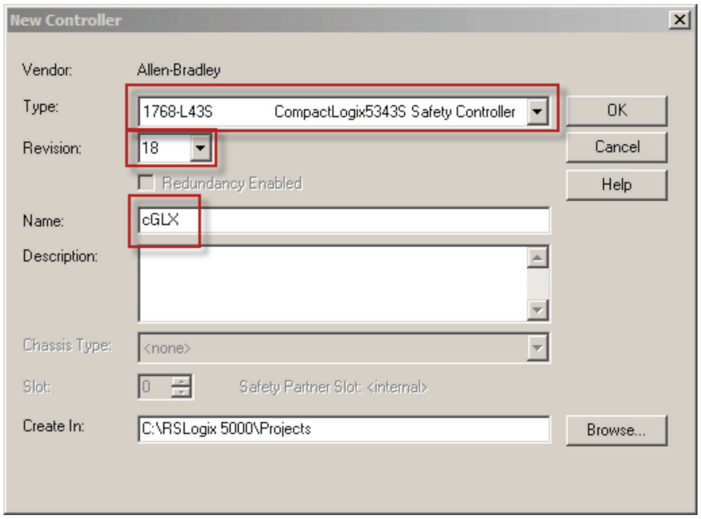
Configuration

The Compact GuardLogix controller is configured by using RSLogix™ 5000 software, version 17 or later. You must create a new project and add the I/O modules. Then, configure the I/O modules for the correct input and output types. A detailed description of each step is beyond the scope of this document. Knowledge of the RSLogix programming environment is assumed.

Configure the Controller and Add I/O Modules

Follow these steps.

1. In RSLogix 5000 software, create a new project.



New Controller

Vendor: Allen-Bradley

Type: 1768-L43S CompactLogix5343S Safety Controller

Revision: 18

□ Redundancy Enabled

Name: cGLX

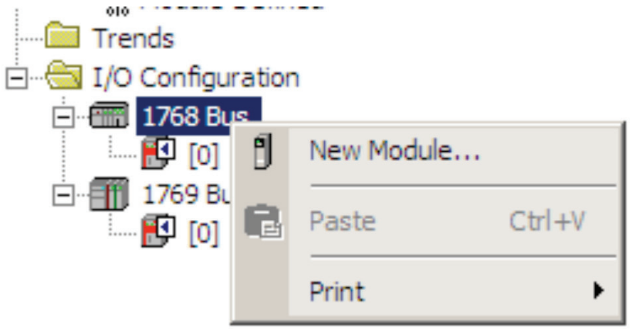
Description:

Chassis Type: <none>

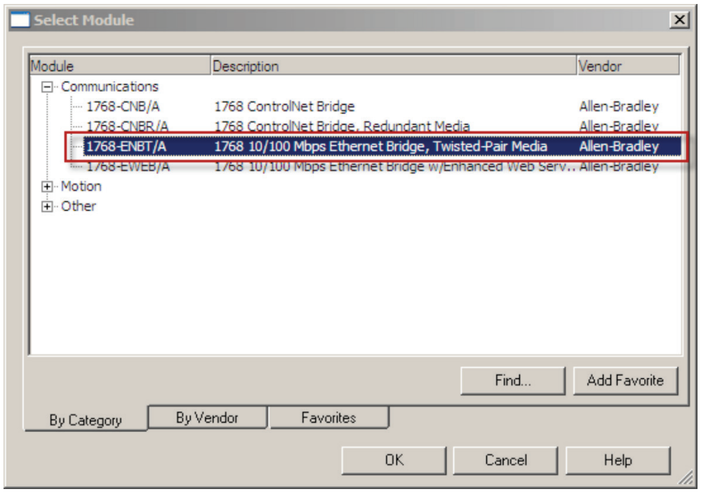
Slot: 0 Safety Partner Slot: <internal>

Create In: C:\RSLogix 5000\Projects

2. In the Controller Organizer, add the 1768-ENBT module to the 1768 Bus.



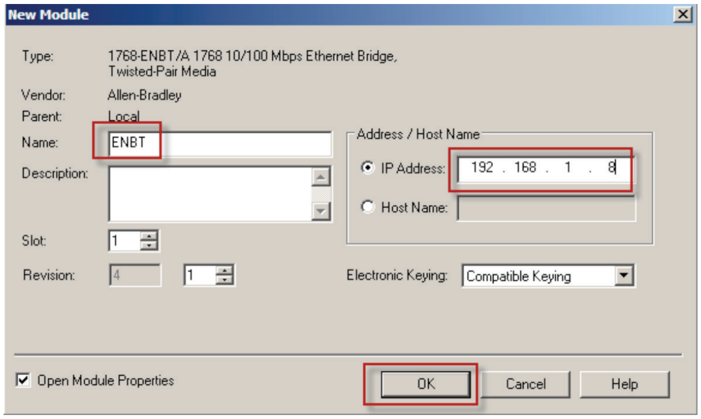
3. Select the 1768-ENBT module and click OK.



Select Module

Module	Description	Vendor
Communications		
1768-CNB/A	1768 ControlNet Bridge	Allen-Bradley
1768-CNBR/A	1768 ControlNet Bridge, Redundant Media	Allen-Bradley
1768-ENBT/A	1768 10/100 Mbps Ethernet Bridge, Twisted-Pair Media	Allen-Bradley
1768-EWEB/A	1768 10/100 Mbps Ethernet Bridge w/Enhanced Web Serv...	Allen-Bradley
Motion		
Other		

4. Name the module, type its IP address, and click OK.
We used 192.168.1.8 for this application example. Yours may be different.



New Module

Type: 1768-ENBT/A 1768 10/100 Mbps Ethernet Bridge, Twisted-Pair Media

Vendor: Allen-Bradley

Parent: Local

Name: ENBT

Description:

Slot: 1

Revision: 4 1

Address / Host Name

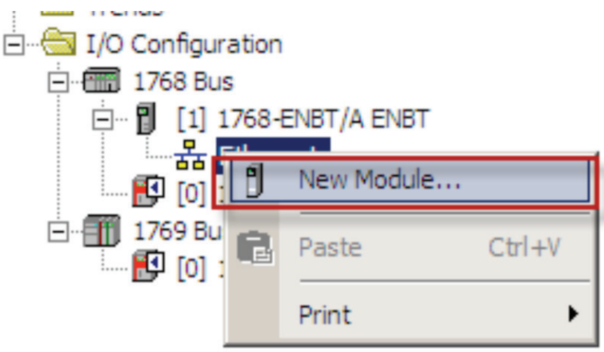
● IP Address: 192 . 168 . 1 . 8

○ Host Name:

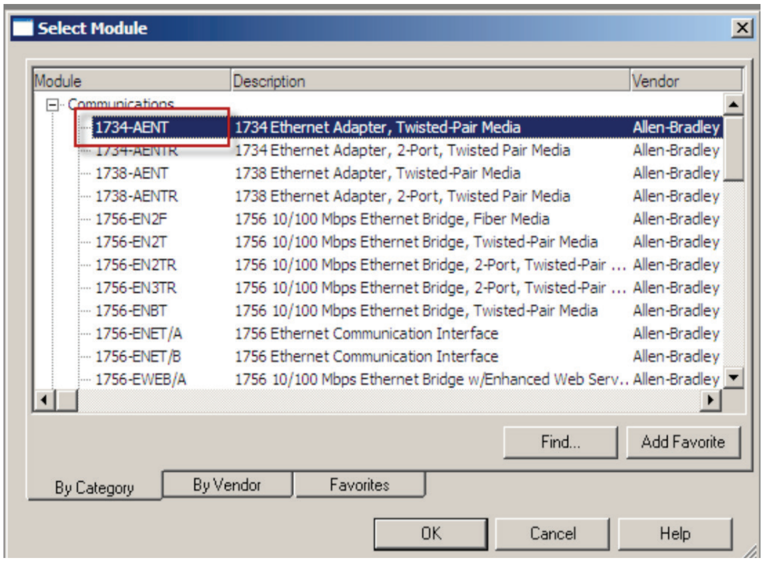
Electronic Keying: Compatible Keying

☑ Open Module Properties

5. Add the 1734-AENT adapter by right-clicking the 1768-ENBT module in the Controller Organizer and choosing New Module.



6. Select the 1734-AENT adapter and click OK.

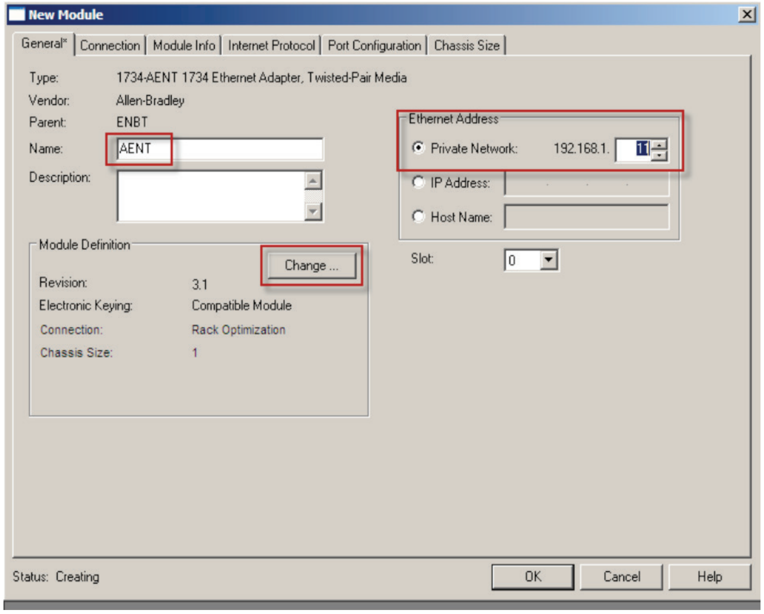


Select Module

Module	Description	Vendor
Communications		
1734-AENT	1734 Ethernet Adapter, Twisted-Pair Media	Allen-Bradley
1734-AENTR	1734 Ethernet Adapter, 2-Port, Twisted Pair Media	Allen-Bradley
1738-AENT	1738 Ethernet Adapter, Twisted-Pair Media	Allen-Bradley
1738-AENTR	1738 Ethernet Adapter, 2-Port, Twisted Pair Media	Allen-Bradley
1756-EN2F	1756 10/100 Mbps Ethernet Bridge, Fiber Media	Allen-Bradley
1756-EN2T	1756 10/100 Mbps Ethernet Bridge, Twisted-Pair Media	Allen-Bradley
1756-EN2TR	1756 10/100 Mbps Ethernet Bridge, 2-Port, Twisted-Pair ...	Allen-Bradley
1756-EN3TR	1756 10/100 Mbps Ethernet Bridge, 2-Port, Twisted-Pair ...	Allen-Bradley
1756-ENBT	1756 10/100 Mbps Ethernet Bridge, Twisted-Pair Media	Allen-Bradley
1756-ENET/A	1756 Ethernet Communication Interface	Allen-Bradley
1756-ENET/B	1756 Ethernet Communication Interface	Allen-Bradley
1756-EWEB/A	1756 10/100 Mbps Ethernet Bridge w/Enhanced Web Serv..	Allen-Bradley

7. Name the module, type its IP address, and click OK.
   We used 192.168.1.11 for this application example. Yours may be different.

8. Click Change.



New Module

Type: 1734-AENT 1734 Ethernet Adapter, Twisted-Pair Media

Vendor: Allen-Bradley

Parent: ENBT

Name: AENT

Description:

Module Definition

Revision: 3.1

Electronic Keying: Compatible Module

Connection: Rack Optimization

Chassis Size: 1

Ethernet Address

● Private Network: 192.168.1. 11

○ IP Address:

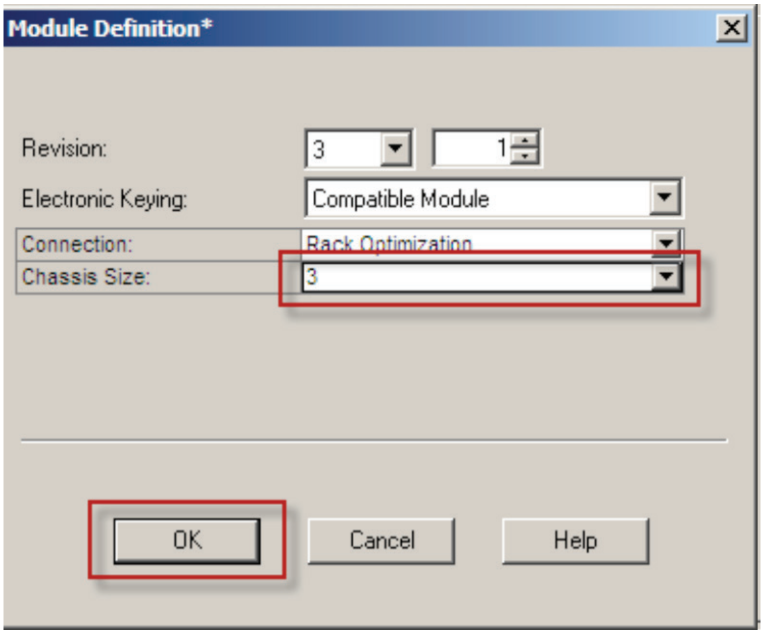
○ Host Name:

Slot: 0

Status: Creating

9. Set the Chassis Size as 3 for the 1734-AENT adapter and click OK.

   Chassis size is the number of modules that will be inserted in the chassis. The 1734-AENT adapter is considered to be in slot 0, so for one input and one output module, the chassis size is 3.



Module Definition*

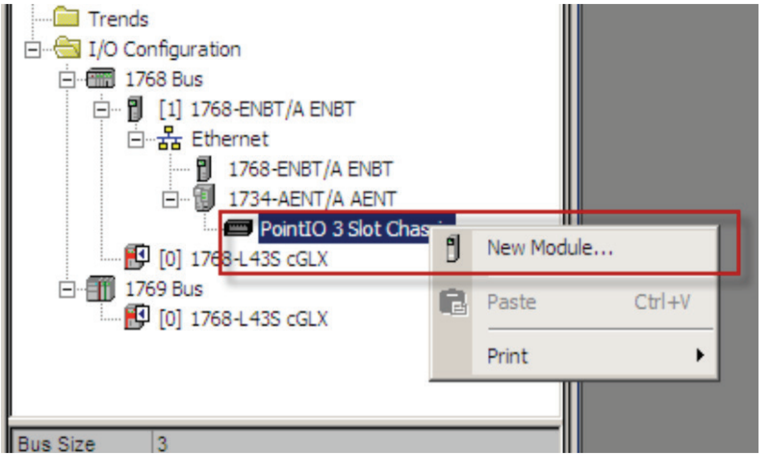
Revision: 3 1

Electronic Keying: Compatible Module

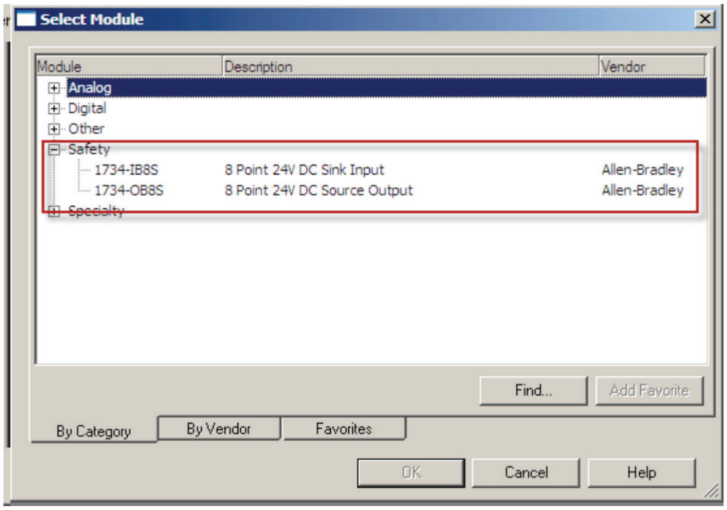
Connection: Rack Optimization

Chassis Size: 3

10. In the Controller Organizer, right-click the 1734-AENT adapter and choose New Module.

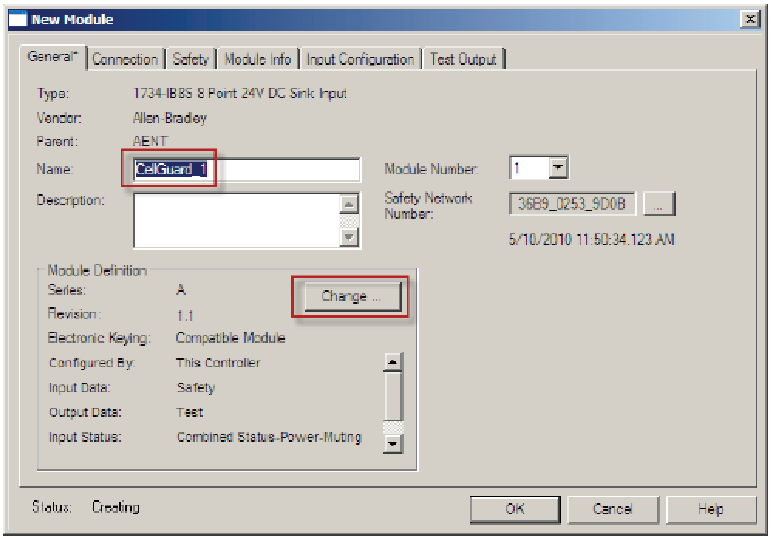


11. Expand Safety, select the 1734-IB8S module, and click OK.



Module	Description	Vendor
⊞ Analog		
⊞ Digital		
⊞ Other		
⊟ Safety		
1734-IB8S	8 Point 24V DC Sink Input	Allen-Bradley
1734-OB8S	8 Point 24V DC Source Output	Allen-Bradley
⊞ Specialty		

12. In the New Module dialog box, name the device ‘CellGuard_1’ and click Change.

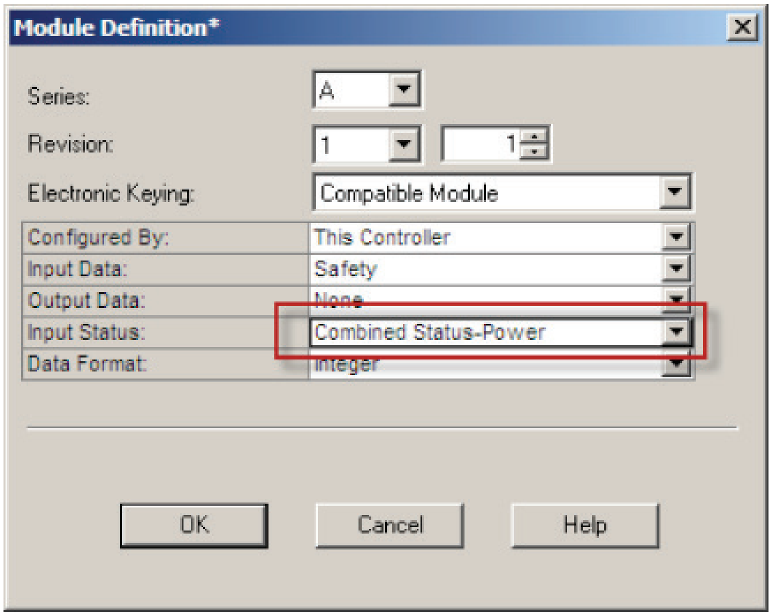


Type: 1734-IB8S 8 Point 24V DC Sink Input
Vendor: Allen-Bradley
Parent: AENT
Name: CellGuard_1
Description:
Module Number: 1
Safety Network Number: 36B9_0253_9D0B
5/10/2010 11:50:34.123 AM

Module Definition
Series: A
Revision: 1.1
Electronic Keying: Compatible Module
Configured By: This Controller
Input Data: Safety
Output Data: Test
Input Status: Combined Status-Power-Muting

Status: Creating

13. When the Module Definition dialog box opens, change the Input Status to Combined Status-Power, and click OK.



Module Definition*

Series: A

Revision: 1 1

Electronic Keying: Compatible Module

Configured By:	This Controller
Input Data:	Safety
Output Data:	None
Input Status:	Combined Status-Power
Data Format:	Integer

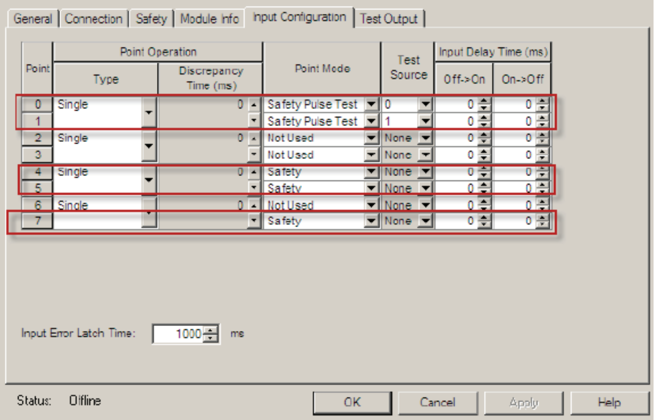
14. Close the Module Properties dialog box by clicking OK.

15. Repeat steps 10-14 to add the 1734-OB8S safety output module.

Configure the I/O Modules

Follow these steps to configure the POINT Guard I/O modules.

1. In the Controller Organizer, right-click the 1734-IB8S module and choose Properties.
2. Click Input Configuration and configure the module as shown.

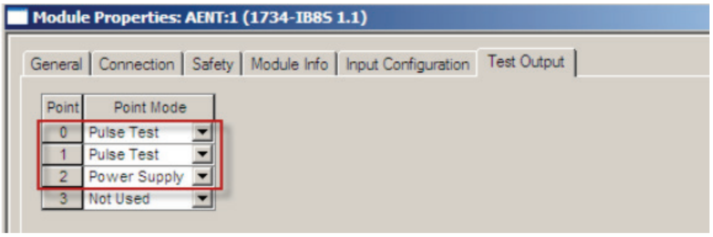


Point	Point Operation		Point Mode	Test Source	Input Delay Time (ms)	
	Type	Discrepancy Time (ms)			Off->On	On->Off
0	Single	0	Safety Pulse Test	0	0	0
1			Safety Pulse Test	1	0	0
2	Single	0	Not Used	None	0	0
3			Not Used	None	0	0
4	Single	0	Safety	None	0	0
5			Safety	None	0	0
6	Single	0	Not Used	None	0	0
7			Safety	None	0	0

Input Error Latch Time: 1000 ms

Status: Offline

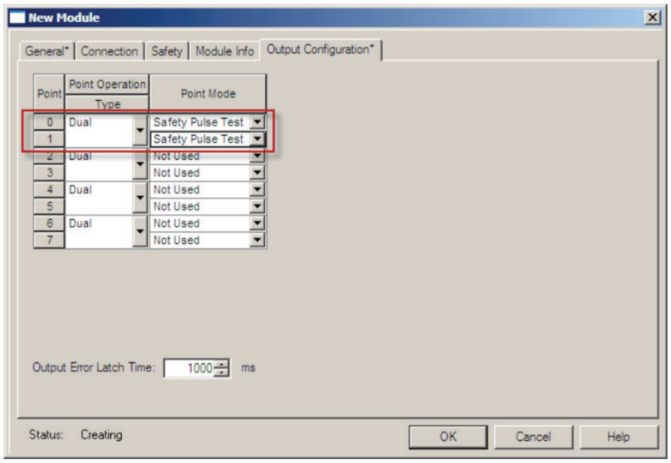
3. Click Test Output and configure the module as shown.



Module Properties: AENT:1 (1734-IB8S 1.1)

Point	Point Mode
0	Pulse Test
1	Pulse Test
2	Power Supply
3	Not Used

4. Click OK.
5. In the Controller Organizer, right-click the 1734-OB8S module and choose Properties.
6. Click Output Configuration and configure the module as shown.



New Module

Point	Point Operation	Point Mode
	Type	
0	Dual	Safety Pulse Test
1		Safety Pulse Test
2	Dual	Not Used
3		Not Used
4	Dual	Not Used
5		Not Used
6	Dual	Not Used
7		Not Used

Output Error Latch Time: 1000 ms

Status: Creating

7. Click OK.

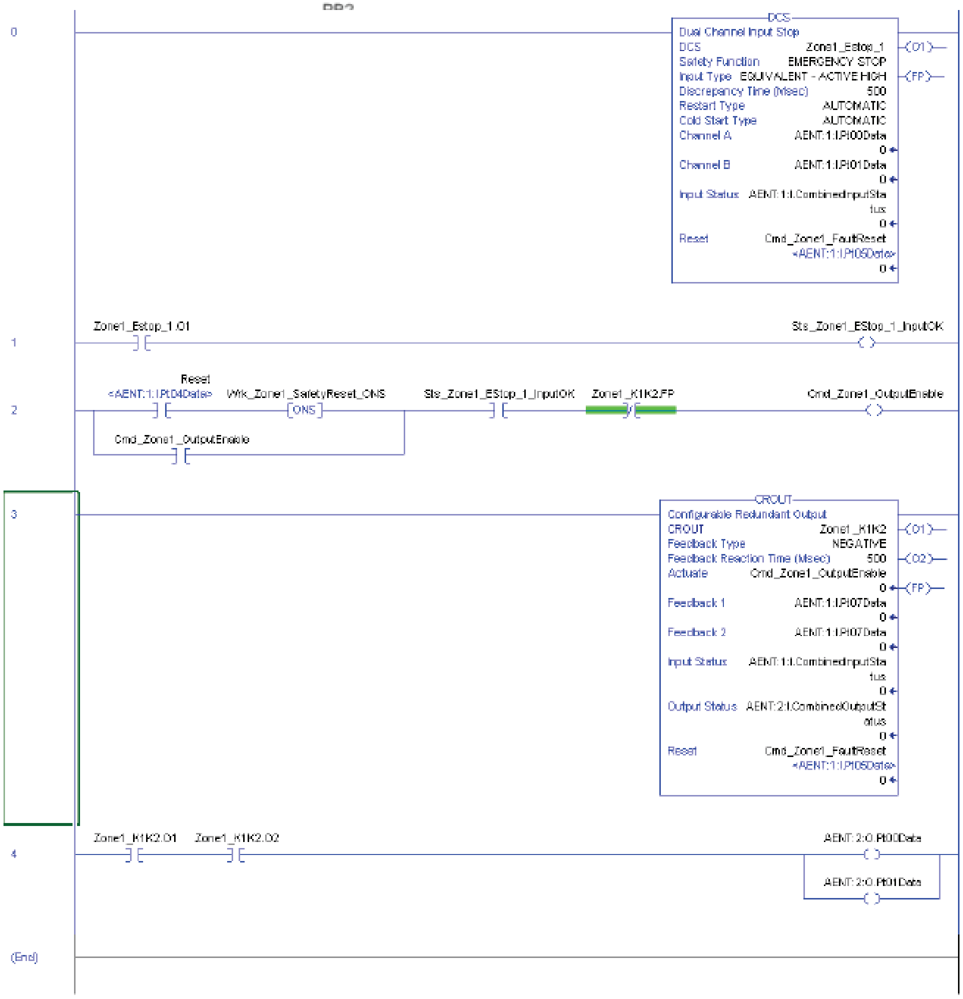
Programming

The Dual Channel Input Stop (DCS) instruction monitors dual-input safety devices whose main function is to stop a machine safely, for example, an E-stop, light curtain, or safety gate. This instruction can only energize Output 1 when both safety inputs, Channel A and Channel B, are in the active state as determined by the Input Type parameter, and the correct reset actions are carried out. The DCS instruction monitors dual-input channels for consistency (Equivalent – Active High) and detects and traps faults when the inconsistency is detected for longer than the configured Discrepancy Time (ms).

The Configurable Redundant Output (CROUT) instruction controls and monitors redundant outputs. The reaction time for output feedback is configurable. The instruction supports positive and negative feedback signals.

The safety application code in the safety output routine prevents outputs from restarting if the input channel resets automatically, providing anti-tiedown functionality for the Circuit Reset.

The Input OK status is used as a permissive in the safety output routines.

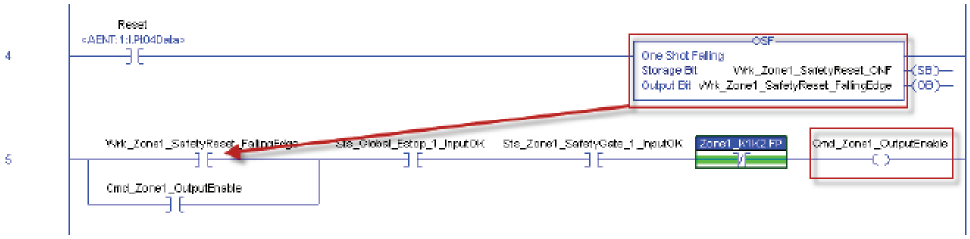


```
0    DCS
     Dual Channel Input Stop
     DCS                          Zone1_Estop_1          (O1)
     Safety Function              EMERGENCY STOP
     Input Type                   EQUIVALENT - ACTIVE HIGH (FP)
     Discrepancy Time (Msec)      500
     Restart Type                 AUTOMATIC
     Cold Start Type              AUTOMATIC
     Channel A                    AENT:1:I.Pt00Data
                                  0
     Channel B                    AENT:1:I.Pt01Data
                                  0
     Input Status                 AENT:1:I.CombinedInputSta
                                  tus
                                  0
     Reset                        Cmd_Zone1_FaultReset
                                  <AENT:1:I.Pt05Data>
                                  0

1    Zone1_Estop_1.O1                                   Sts_Zone1_EStop_1_InputOK
     ] [                                                ( )

2    Reset
     <AENT:1:I.Pt04Data>  Wrk_Zone1_SafetyReset_ONS  Sts_Zone1_EStop_1_InputOK  Zone1_K1K2.FP  Cmd_Zone1_OutputEnable
     ] [                  [ONS]                      ] [                        ]/[            ( )
     Cmd_Zone1_OutputEnable
     ] [

3    CROUT
     Configurable Redundant Output
     CROUT                        Zone1_K1K2             (O1)
     Feedback Type                NEGATIVE
     Feedback Reaction Time (Msec) 500                   (O2)
     Actuate                      Cmd_Zone1_OutputEnable
                                  0                      (FP)
     Feedback 1                   AENT:1:I.Pt07Data
                                  0
     Feedback 2                   AENT:1:I.Pt07Data
                                  0
     Input Status                 AENT:1:I.CombinedInputSta
                                  tus
                                  0
     Output Status                AENT:2:I.CombinedOutputSt
                                  atus
                                  0
     Reset                        Cmd_Zone1_FaultReset
                                  <AENT:1:I.Pt05Data>
                                  0

4    Zone1_K1K2.O1  Zone1_K1K2.O2                       AENT:2:O.Pt00Data
     ] [            ] [                                 ( )
                                                        AENT:2:O.Pt01Data
                                                        ( )

(End)
```

Falling Edge Reset

ISO 13849-1 stipulates that instruction reset functions must occur on falling edge signals. To comply with this requirement, add a One Shot Falling instruction to the rung immediately preceding the Cmd_Zone1_OutputEnable rung, Then use the OSF instruction Output Bit tag as the reset bit for the following rung. The Cmd_Zone1_OutputEnable is then used to Enable the CROUT instruction.

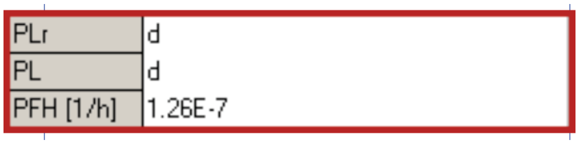
Modify the reset code as shown below.


4
Reset
<AENT:1:I.Pt04Data>
OSF
One Shot Falling
Storage Bit Wrk_Zone1_SafetyReset_ONF
Output Bit Wrk_Zone1_SafetyReset_FallingEdge
(SB)
(OB)
5
Wrk_Zone1_SafetyReset_FallingEdge
Cmd_Zone1_OutputEnable
Sts_Global_Estop_1_InputOK
Sts_Zone1_SafetyGate_1_InputOK
Zone1_K1K2 FP
Cmd_Zone1_OutputEnable

Calculation of the Performance Level

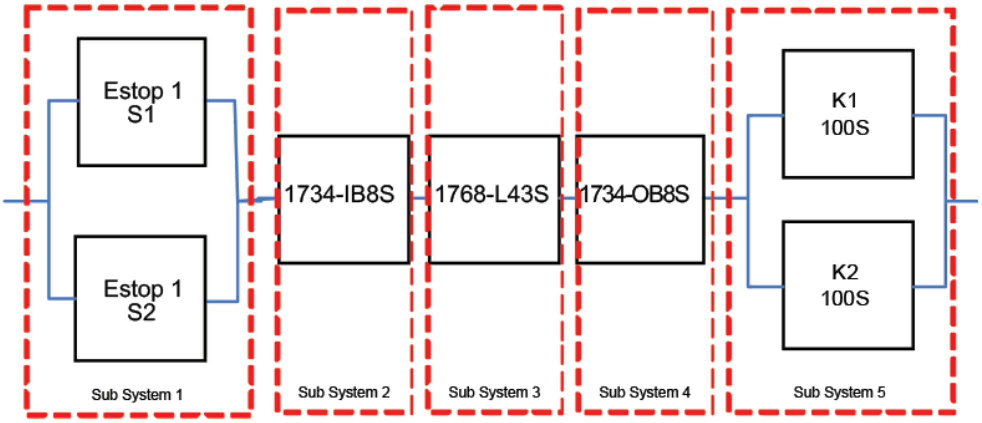
When configured correctly, the safety system can achieve a safety rating of PLd, Cat. 3 according to EN ISO 13849.1 2008.

The Functional Safety Specifications of the project call for a Performance Level on PLd (minimum) and a structure of Cat 3 (minimum). A PFHd of less than 1.0 E-06 for the overall safety function is required for PLd.



PLr	d
PL	d
PFH [1/h]	1.26E-7

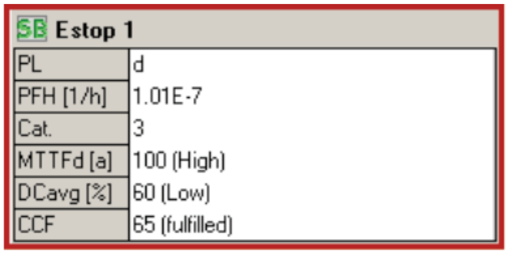
When modeled in SISTEMA, each safety E-stop string is treated as an individual safety function and can be modeled as follows. This diagram shows a single E-stop safety function.



Calculations are based on 1 operation of the E-stop per month, with 12 operations per year; therefore 36 operations of contactors per year.

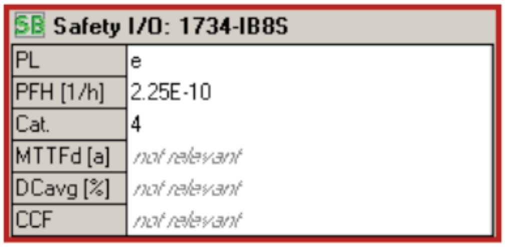
The Diagnostic Coverage (Dcavg) is reduced to 60% for the E-stops because they are connected in series.

The measures against Common Cause Failure (CCF) are quantified using the scoring process outlined in Annex F of ISO 13849-1. For the purposes of the PL calculation, the required score of 65 needed to fulfill the CCF requirement is considered to be met. The complete CCF scoring process must be done when implementing this example.



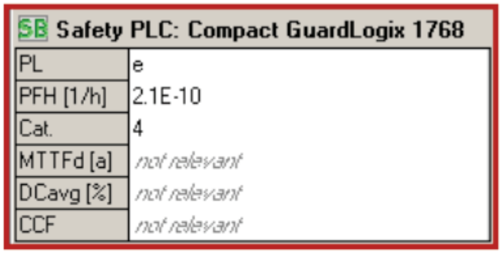
SB Estop 1

PL	d
PFH [1/h]	1.01E-7
Cat.	3
MTTFd [a]	100 (High)
DCavg [%]	60 (Low)
CCF	65 (fulfilled)



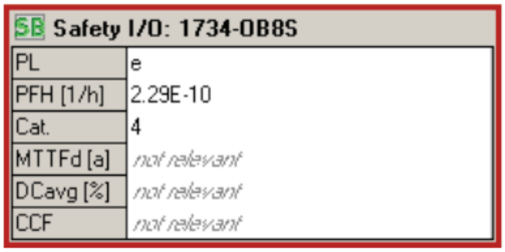
SB Safety I/O: 1734-IB8S

PL	e
PFH [1/h]	2.25E-10
Cat.	4
MTTFd [a]	*not relevant*
DCavg [%]	*not relevant*
CCF	*not relevant*



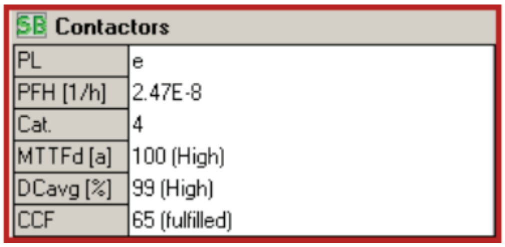
SB Safety PLC: Compact GuardLogix 1768

PL	e
PFH [1/h]	2.1E-10
Cat.	4
MTTFd [a]	*not relevant*
DCavg [%]	*not relevant*
CCF	*not relevant*



SB Safety I/O: 1734-OB8S

PL	e
PFH [1/h]	2.29E-10
Cat.	4
MTTFd [a]	*not relevant*
DCavg [%]	*not relevant*
CCF	*not relevant*



SB Contactors

PL	e
PFH [1/h]	2.47E-8
Cat.	4
MTTFd [a]	100 (High)
DCavg [%]	99 (High)
CCF	65 (fulfilled)

Verification and Validation Plan

Verification and Validation play an important role in the avoidance of faults throughout the safety system design and development process. ISO/EN 13849-2 sets the requirements for verification and validation. It calls for a documented plan to confirm all the Safety Functional Requirements have been met.

Verification is an analysis of the resulting safety control system. The Performance Level (PL) of the safety control system is calculated to confirm it meets the Required Performance Level (PLr) specified. The SISTEMA software tool is typically utilized to perform the calculations and assist with satisfying the requirements of ISO 13849-1.

Validation is a functional test of the safety control system to demonstrate that it meets the specified requirements of the safety function. The safety control system is tested to confirm all of the safety related outputs respond appropriately to their corresponding safety related inputs. The functional test should include normal operating conditions in addition to potential fault inject of failure modes. A checklist is typically used to document the validation of the safety control system.

Validation of software development is a process in which similar methodologies and techniques that are used in hardware development are deployed. Faults created through poor software development process and procedure are systemic in nature rather than faults associated with hardware which are considered as random.

Prior to validating the GuardLogix Safety System, it is necessary to confirm the safety system and safety application program have been designed in accordance with the GuardLogix System Safety Reference Manual (1756-RM093) and the GuardLogix Application Instruction Safety Reference Manual (1756-RM095).

GuardLogix Emergency Stop Function Verification and Validation Checklist

General Machinery Information

Machine Name / Model Number	
Machine Serial Number	
Customer Name	
Test Date	
Tester Name(s)	
Schematic Drawing Number	
Controller Name	
Safety Signature ID	
Safety Network Number(s)	
RSLogix5000 Software Version	

Safety Control System Modules	GuardLogix Modules	Firmware Version
GuardLogix Safety Controller	1768-L43S	
CompactLogix Ethernet Bridge	1768-ENBT	
POINT I/O Ethernet Adapter	1734-AENT	
POINT I/O Input Modules	1734-IB8S	
POINT I/O Output Modules	1734-OB8S	

GuardLogix Safety System Configuration and Wiring Verification

Test Step	Verification	Pass/Fail	Changes/Modifications
1	Verify the safety system has been designed in accordance with the GuardLogix System Safety Reference Manual 1756-RM093.		
2	Verify the safety application program has been designed in accordance with the GuardLogix Application Instruction Safety Reference Manual 1756-RM095.		
3	Visually inspect the safety system network and I/O is wired as documented in the schematics.		
4	Visually inspect the RSLogix 5000 program to verify that the safety system network and I/O module configuration is configured as documented.		
5	Visually inspect the RSLogix 5000 application program to verify suitable safety certified instructions are utilized. The logic is readable, understandable and testable with the aid of clear comments.		
6	All input devices are qualified by cycling their respective actuators. Monitor the status in the RSLogix 5000 Controller Tags window.		
7	All output devices are qualified by cycling their respective actuators. Monitor the status in the RSLogix 5000 Controller Tags window.		

Normal Operation Verification - The GuardLogix safety system properly responds to all normal Start, Stop, Enabling and Reset Commands

Test Step	Verification	Pass/Fail	Changes/Modifications
1	Initiate a Start Command. Both contactors should energize for a normal machine run condition. Verify proper machine status indication and RSLogix 5000 safety application program indication.		
2	Initiate a Stop Command. Both contactors should de-energize for a normal machine Stop condition. Verify proper machine status indication and RSLogix 5000 safety application program indication.		
3	While Running, press the E-Stop pushbutton. Both contactors should remain de-energized and open for a normal safe condition. Verify proper machine status indication and RSLogix 5000 safety application program indication. Repeat for all E-Stop pushbuttons.		
4	While Stopped, press the E-Stop pushbutton and initiate a Start Command. Both contactors should remain de-energized and open for a normal safe condition. Verify proper machine status indication and RSLogix 5000 safety application program indication. Repeat for all E-Stop pushbuttons.		
5	Initiate Reset Command. Both contactors should remain de-energized. Verify proper machine status indication and RSLogix 5000 safety application program indication.		

Abnormal Operation Verification - The GuardLogix safety system properly responds to all foreseeable faults with corresponding diagnostics.

E-Stop Input Tests

Test Step	Validation	Pass/Fail	Changes/Modifications
1	While Running, remove the Channel 1 wire from the Safety I/O. Both contactors should de-energize. Verify proper machine status indication and RSLogix 5000 safety application program indication. Restore Channel 1 and repeat for Channel 2.		
2	While Running, short the Channel 1 of the Safety I/O to +24VDC. Both contactors should de-energize. Verify proper machine status indication and RSLogix 5000 safety application program indication. Verify unable to reset and restart with fault. Restore Channel 1 and repeat for Channel 2.		
3	While Running, short the Channel 1 of the Safety I/O to (-) 0VDC. Both contactors should de-energize. Verify proper machine status indication and RSLogix 5000 safety application program indication Restore Channel 1 and repeat for Channel 2.		
4	While Running, short the Channels 1 & 2 of the Safety I/O. Both contactors should de-energize. Verify proper machine status indication and RSLogix 5000 safety application program indication. Restore Channel 1 & 2 wiring.		

GuardLogix Controller and Network Tests

Test Step	Validation	Pass/Fail	Changes/Modifications
1	While Running, remove the Ethernet network connection between the Safety I/O and the controller. All contactors should de-energize. Verify proper machine status indication and I/O Connection Status in the RSLogix 5000 safety application program.		
2	Restore the Safety I/O module network connection and allow time to reestablish communication. Verify the Connection Status Bit in the RSLogix 5000 safety application program. Repeat for all Safety I/O connections.		
3	While Running, switch the controller out of Run Mode. All contactors should de-energize. Return key switch back to Run Mode, all contactors should remain de-energized. Verify proper machine status indication and RSLogix 5000 safety application program indication.		

Safety Contactor Output Tests

Test Step	Validation	Pass/Fail	Changes/Modifications
1	Initiate a Start Command. Both contactors should energize for a normal machine run condition. Verify proper machine status indication and RSLogix 5000 safety application program indication.		
2	While Running, remove the contactor feedback from the Safety I/O. All contactors should remain energized. Initiate a Stop command and attempt a Reset command. The system should not Restart or Reset. Verify proper machine status indication and RSLogix 5000 safety application program indication.		
3	While Running, short the contactor feedback to the Safety I/O. All contactors should remain energized. Initiate a Stop command and attempt a Reset command. The system should not Restart or Reset. Verify proper machine status indication and RSLogix 5000 safety application program indication.		

Additional Resources

For more information about the products used in this example refer to these resources.

Resource	Description
Compact GuardLogix Controllers User Manual, Publication 1768-UM002	Provides information on configuring, operating, and maintaining Compact GuardLogix controllers.
POINT Guard I/O Safety Modules Installation and User Manual, Publication 1734-UM013	Provides information on installing, configuring, and operating POINT Guard I/O Modules.
GuardLogix Controller Systems Safety Reference Manual, Publication 1756-RM093	Contains detailed requirements for achieving and maintaining safety ratings with the GuardLogix controller system.
GuardLogix Safety Application Instruction Set Reference Manual, Publication 1756-RM095	Provides detailed information on the GuardLogix Safety Application Instruction Set.
Safety Accelerator Toolkit for GuardLogix Systems Quick Start Guide, Publication IASIMP-QS005	Provides a step-by-step guide to using the design, programming, and diagnostic tools in the Safety Accelerator Toolkit.
Safety Products Catalog	

You can view or download publications at http://www.rockwellautomation.com/literature. To order paper copies of technical documentation, contact your local Allen-Bradley® distributor or Rockwell Automation sales representative.

For More Information on Safety Function Capabilities, visit:

discover.rockwellautomation.com/safety

www.rockwellautomation.com

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